

# The Use of Anthropogenic, Biomass Burning, and Volcanic Emission Estimates for Modeling Particulates Downwind of Mexico City



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# Purpose

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Integrate 3-D regional modeling and field measurements to address the following questions:

- Do models adequately represent evolving aerosol mass, composition, size distribution and optical properties downwind of a megacity?
- What are major uncertainties associated with the regional predictions and how do those uncertainties affect direct radiative forcing?
- Are local processes in the vicinity of Mexico City significant in terms of large-scale modeling?

Tools:

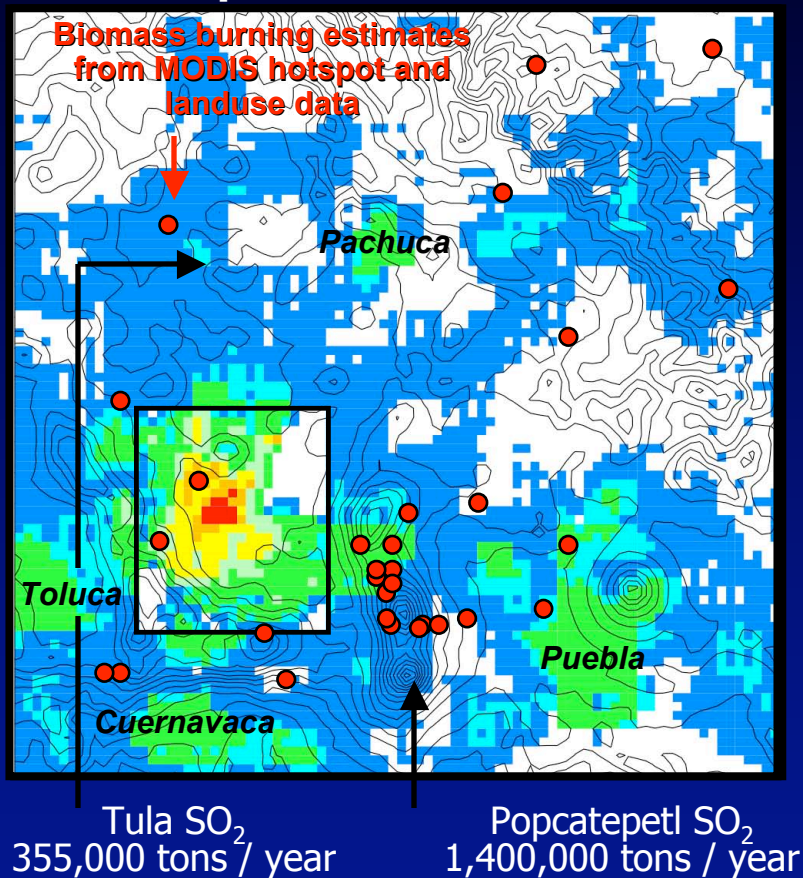
- WRF-chem community model: fully-coupled meteorology, chemistry, particulates that includes aerosol-radiation-cloud feedbacks
- Extensive particulate, precursor trace gases, aerosol optical properties, and radiation measurements

Focus today on uncertainties in primary particulate emissions.



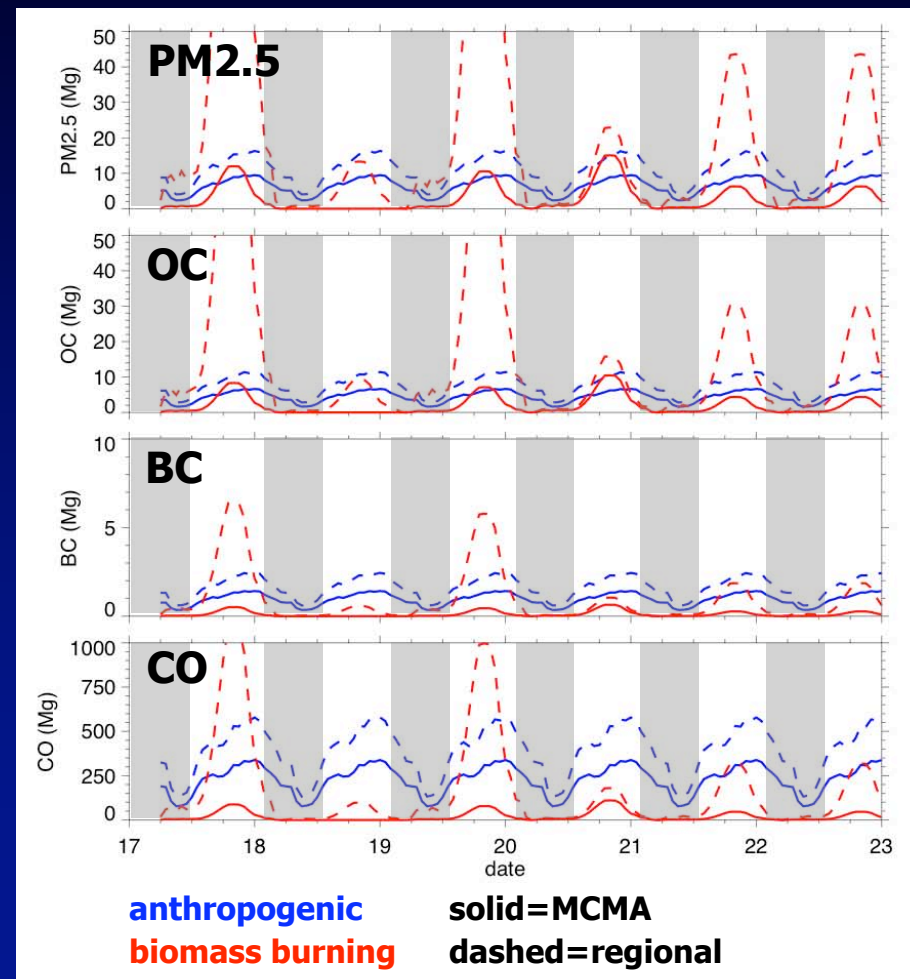
# Particulate Emission Estimates

## Spatial Distribution



- ➔ anthropogenic PM<sub>2.5</sub> ~30,000 ton / year
- ➔ but 1996 Global Inventory [Bond et al., 2004 JGR] has ~255,000 tons / year of OC and BC over Mexico

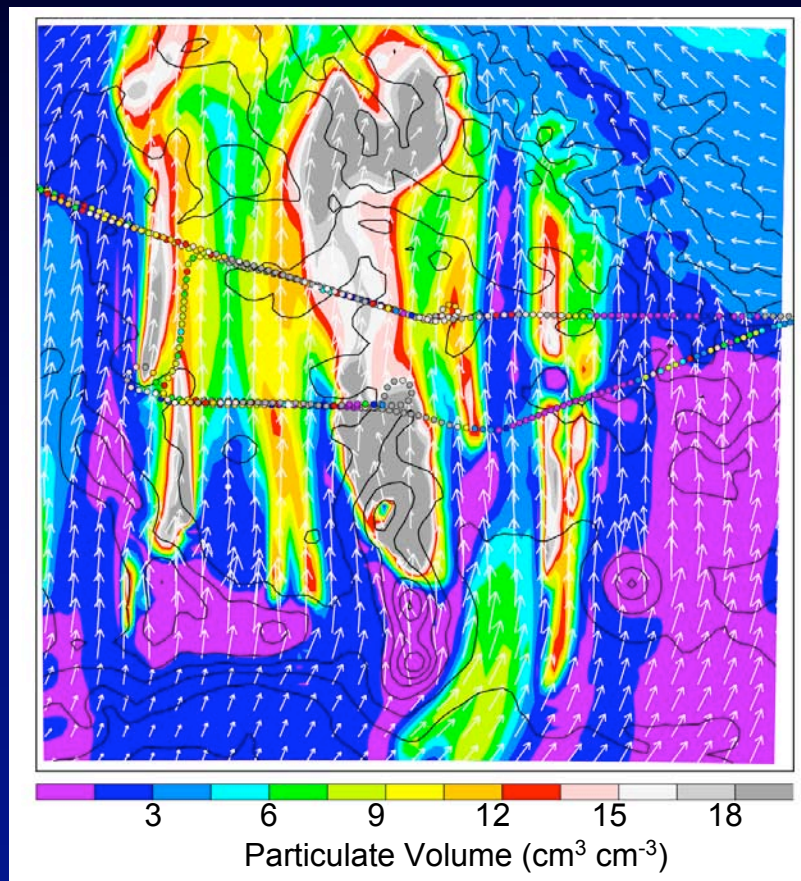
## Diurnal Variations



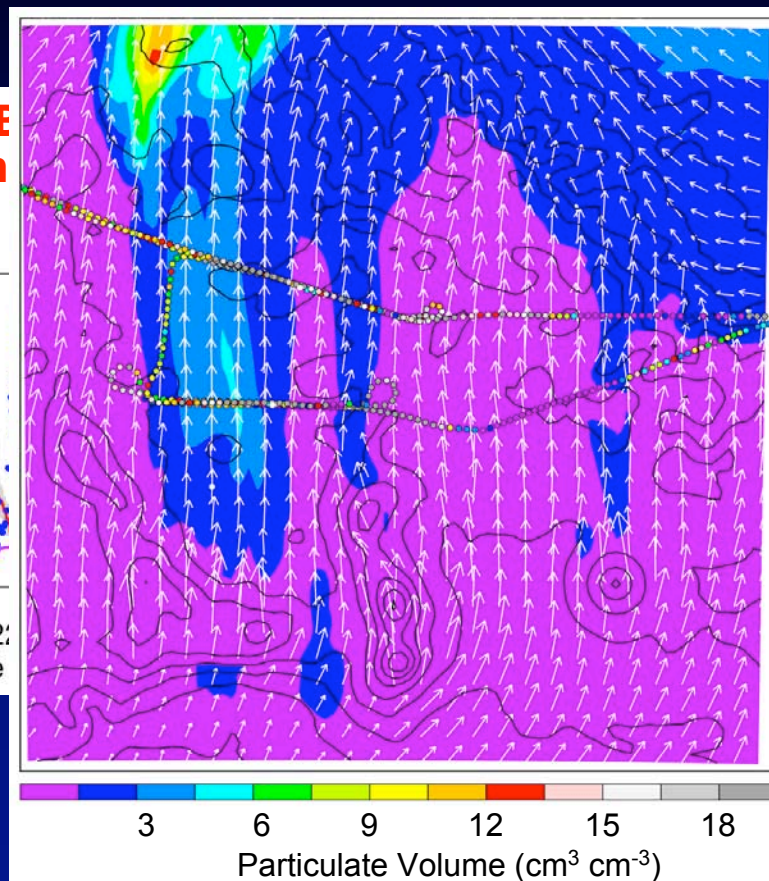
- ➔ biomass burning estimates often larger than anthropogenic

## Predicted Particulate Distributions 22 UTC 19 March 2006

Anthropogenic + Biomass Burning +  
Volcanic Sources



Anthropogenic Emissions Only

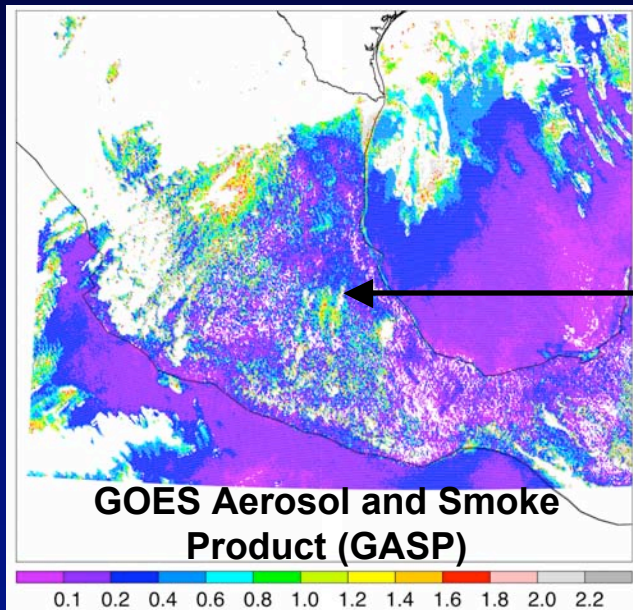


- anthropogenic particulates mix with  $\text{SO}_4$  produced downwind of Popocatepetl and OC and BC from fires downwind of Mexico City
- anthropogenic particulate emissions alone cannot account for observed particulate volume

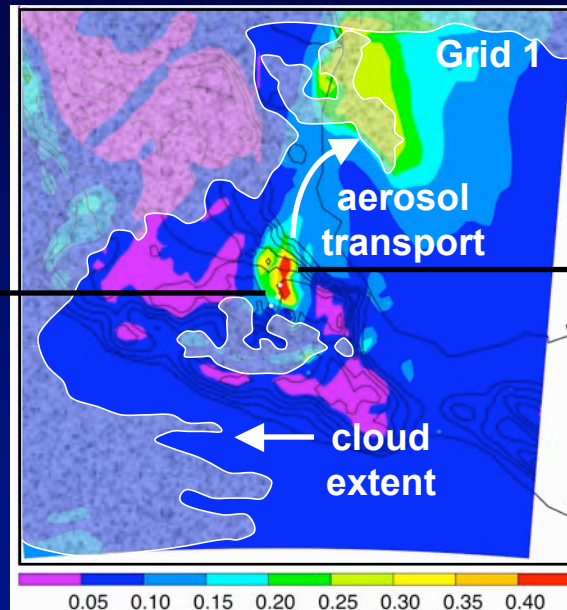


# Linking Local and Large Scales

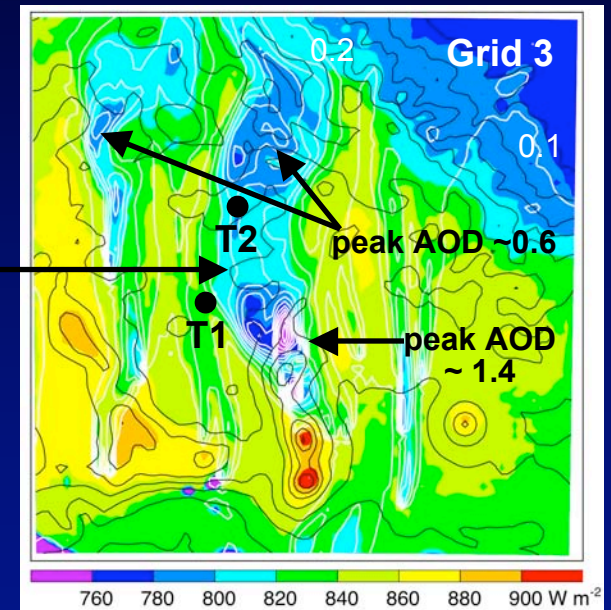
Observed AOD  
21 UTC 19 March



Predicted AOD



Predicted Radiation & AOD



shortwave radiation reduced  
by as much as 100 W m<sup>-2</sup>

simulation without high-resolution domains results in lower AOD  
both over central Mexico and downwind over Gulf of Mexico

# What Next?

- utilize additional data to evaluate model for NE transport cases
- transport age to compare with chemical age
  - ➔ constrain meteorology with data assimilation
  - ➔ tag air parcels by release source in Mexico City and release time
  - ➔ compute transport ages and source/receptor relationships for G-1 flight tracks and at T1 / T2 sites
- month-long simulation period to characterize the Mexico City “footprint” and separate relative contributions of anthropogenic emissions and other sources on aerosol radiative forcing

## Collaborative Activities:

- Alma Hodzic: relative role of biomass burning and anthropogenic sources on particulate loading and aerosol optical properties
- Natalie Mahowald: testing CCSM dust module at local scales and examine interaction of dust and anthropogenic particulates
- Louisa Emmons: linking large-scale and small-scale particulate issues
- Chris Hostetler, Rich Ferrare, John Hair: evaluate simulated extinction profiles and optical properties with B-200 lidar data

# Acknowledgements

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- Bill Gustafson: modeling support
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- Liz Alexander: AMS data
- Chris Doran and Xiao-Ying Yu: T1 / T2 particulate measurements
- Jim Barnard: radiation and albedo data
- Will Shaw, Mikhail Pekour, Rich Coulter: meteorological data

